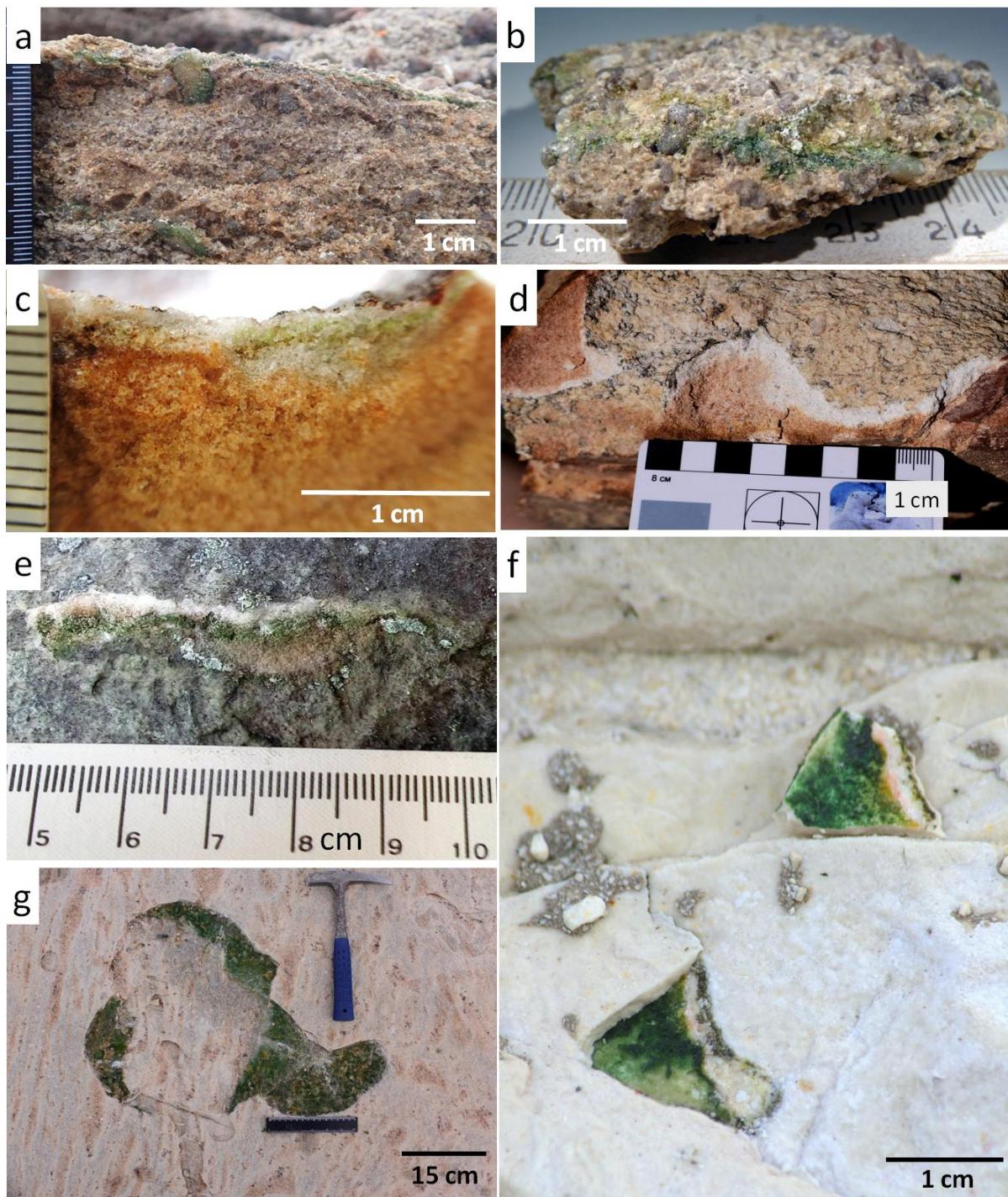


## Supplementary information

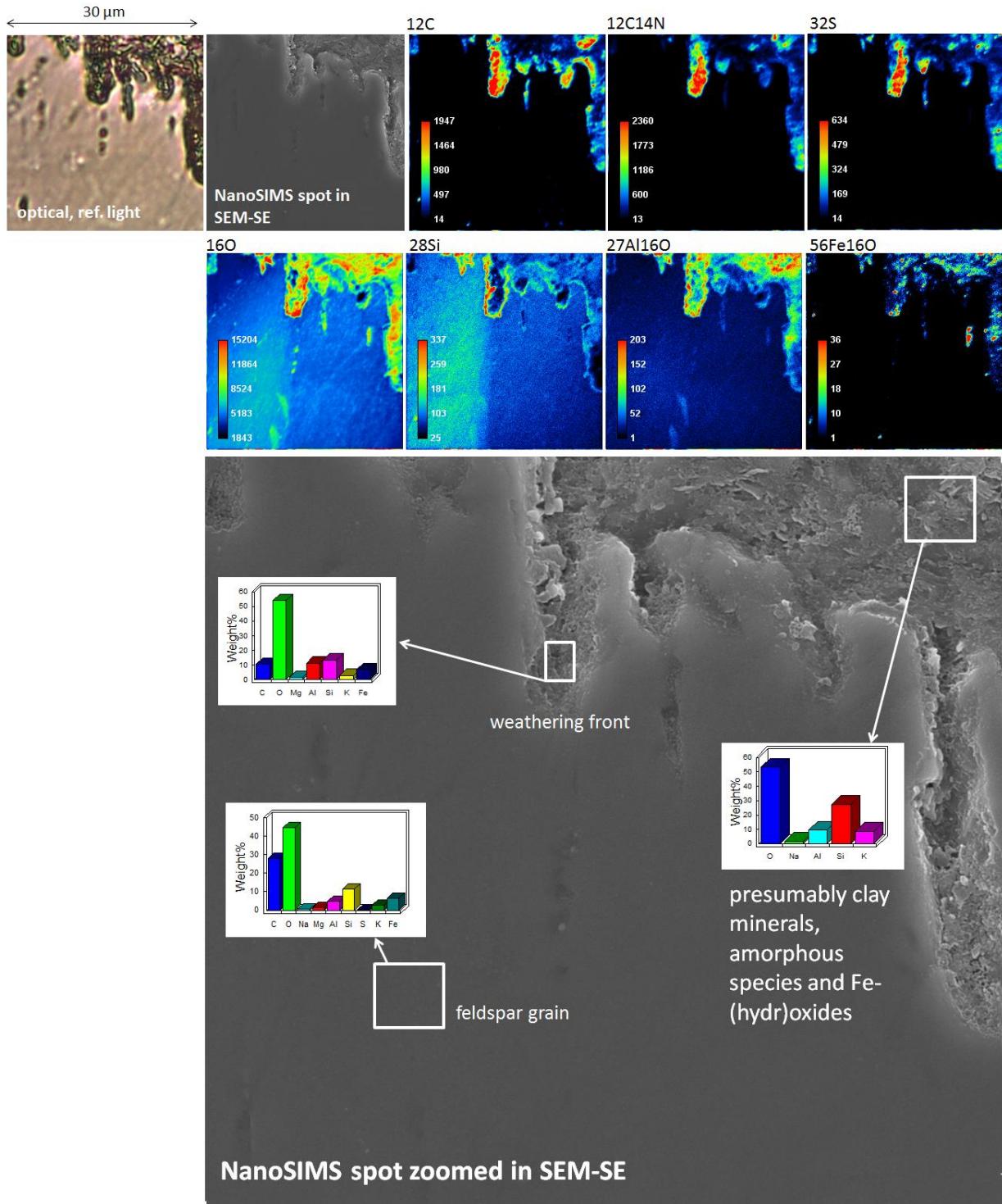
*Article title:* Alteration of rocks by endolithic organisms is one of the pathways for the beginning of soils on Earth  
*Authors:* Nikita Mergelov, Carsten W. Mueller, Isabel Prater, Ilya Shorkunov, Andrey Dolgikh, Elya Zazovskaya, Vasily Shishkov, Victoria Krupskaya, Konstantin Abrosimov, Alexander Cherkinsky, Sergey Goryachkin



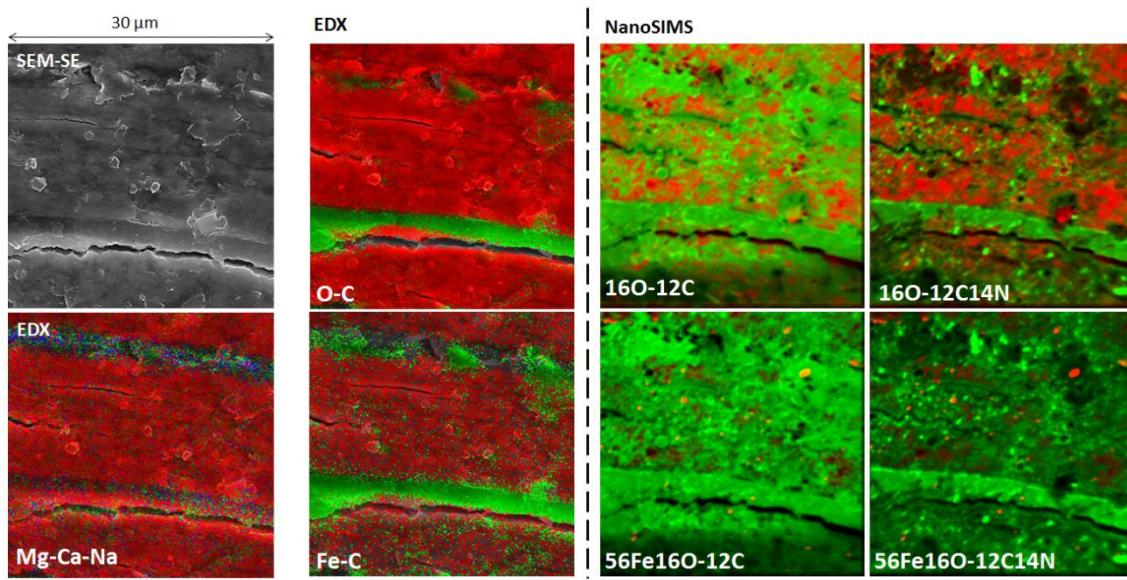
**Figure S1. Endolithic system is a worldwide phenomenon, however only East Antarctica provides the most “clean” environment lacking completely the influence from vascular plants and minimizing effects from epilithic and epi-edaphic biological covers.**

a, b – Cape Zhelanya, Novaya Zemlya High Arctic archipelago, conglomerates with increased quartz content; c – Blyde River canyon, South Africa, quartzite sandstones; d – Cape Fold Mountains, South Africa, quartzite sandstones; e – Plateau Ozark, Missouri, quartzite sandstones; f – Bari, South Italy, carbonate rocks; g – Larsemann Hills, East Antarctica, leucogranite with high quartz content.

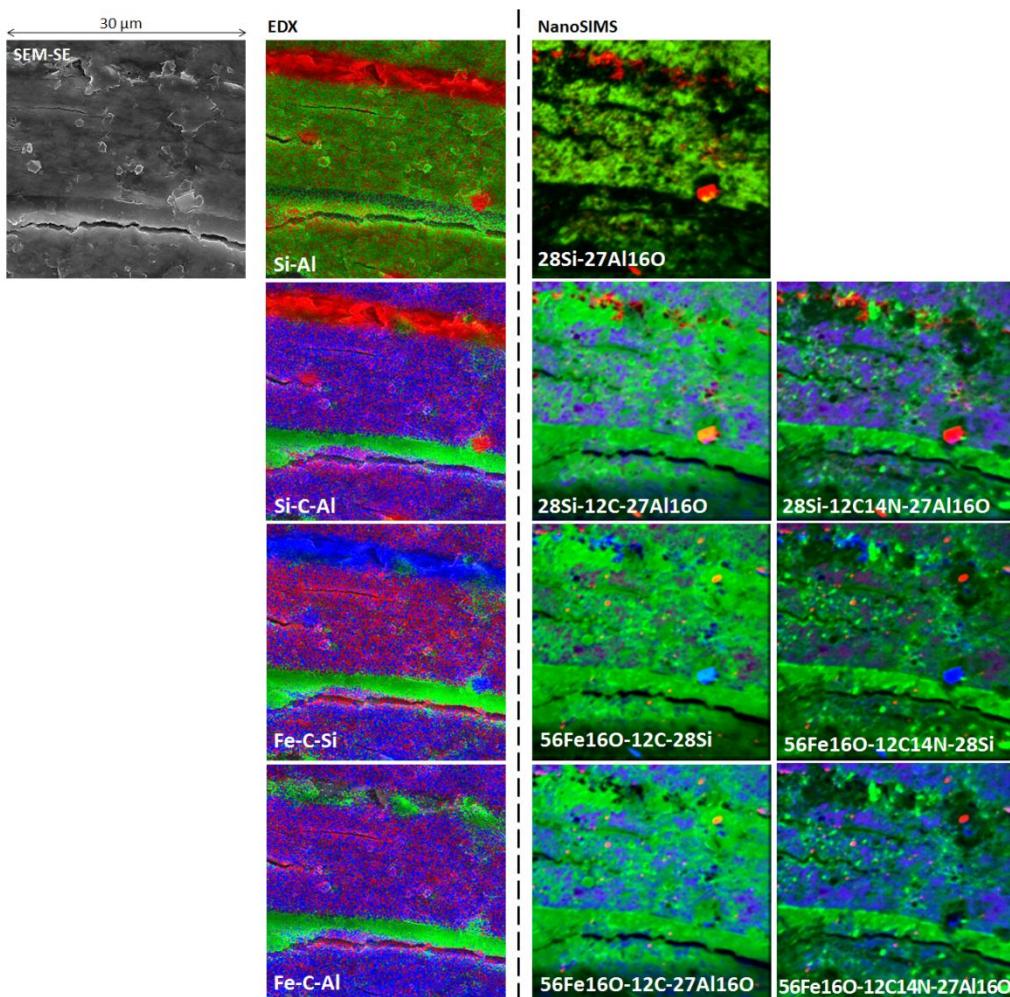
We refer here to the cryptoendolithic varieties. South Africa and Missouri varieties combine both endolithic and epilithic forms of lichen colonization.



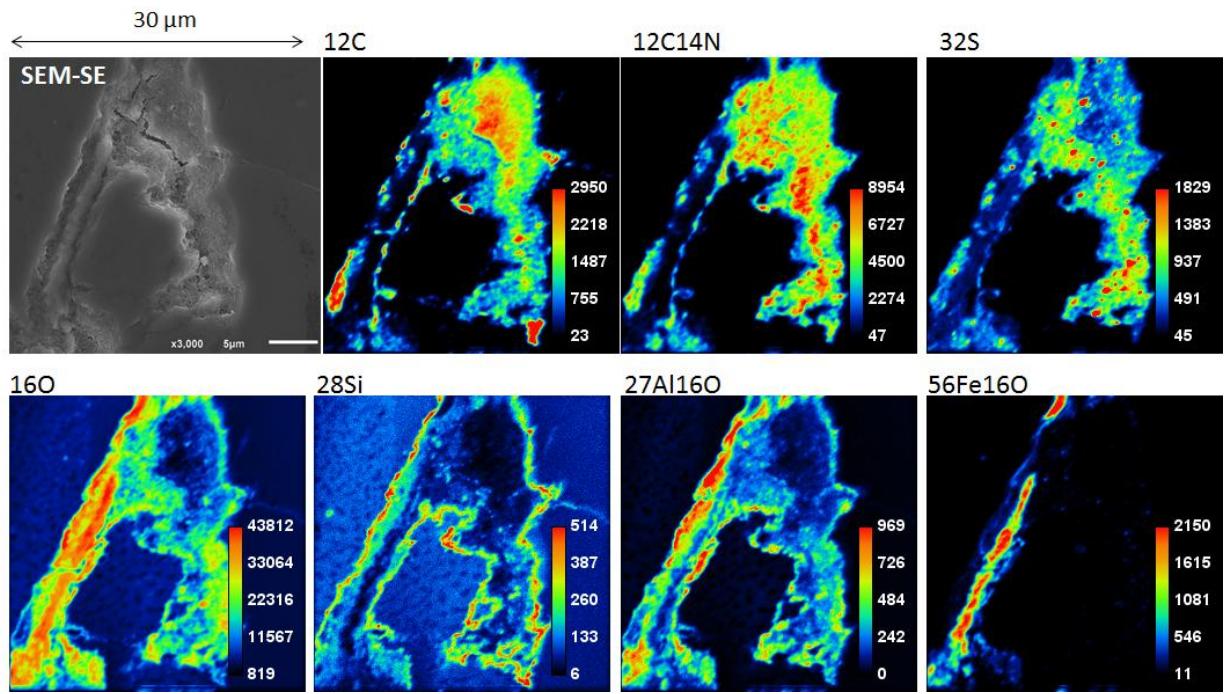
**Figure S2. Weathering seen at the forefront of cyanobacteria-to-feldspar interaction (NanoSIMS data)**



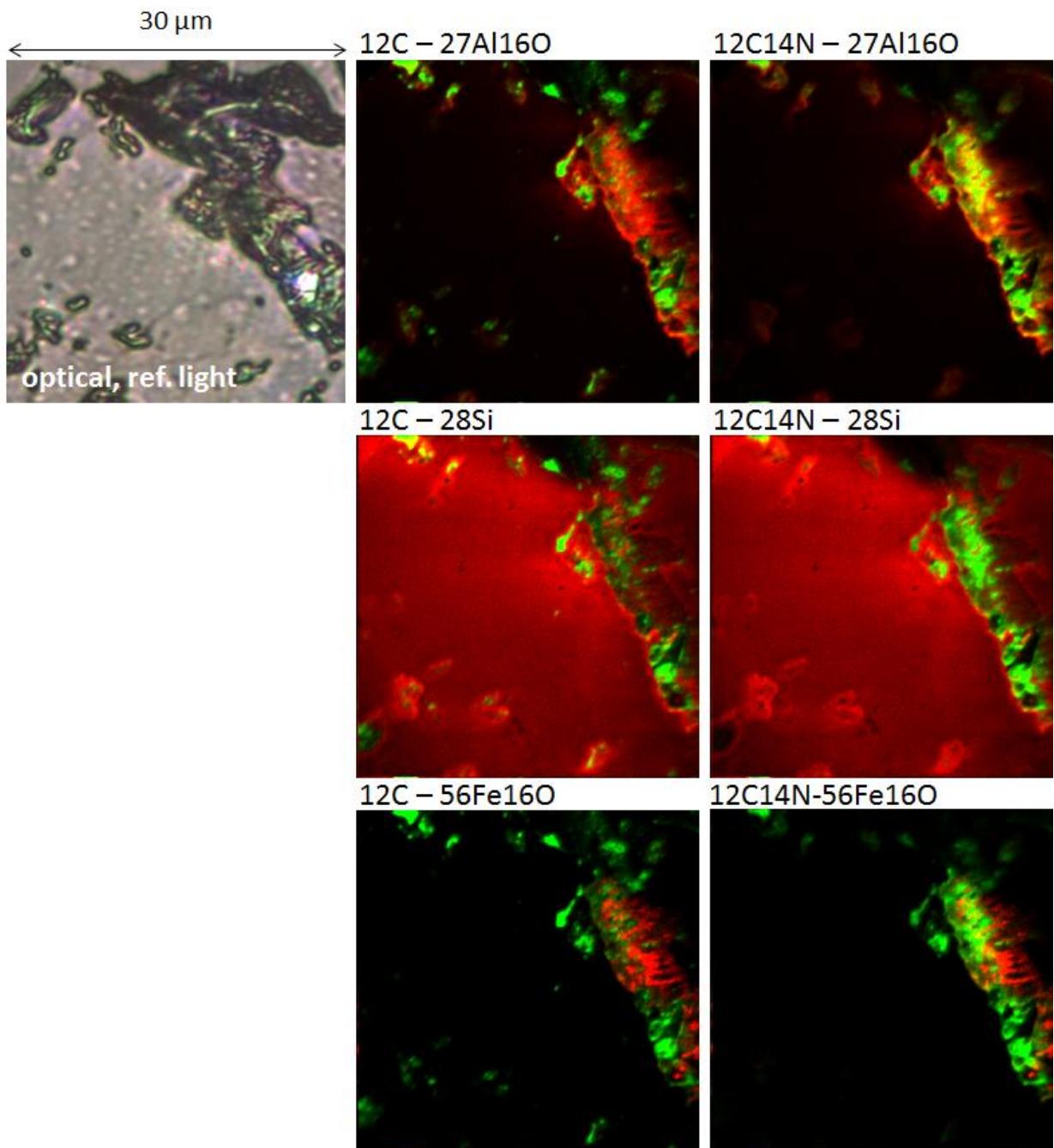
**Figure S3. Comparison of EDX and NanoSIMS elemental distribution in composites (cyanobacterial biofilms interlayered with biotite flakes).**  
**RGB sequence of colors: red matches the first element, green – second, blue – third.**



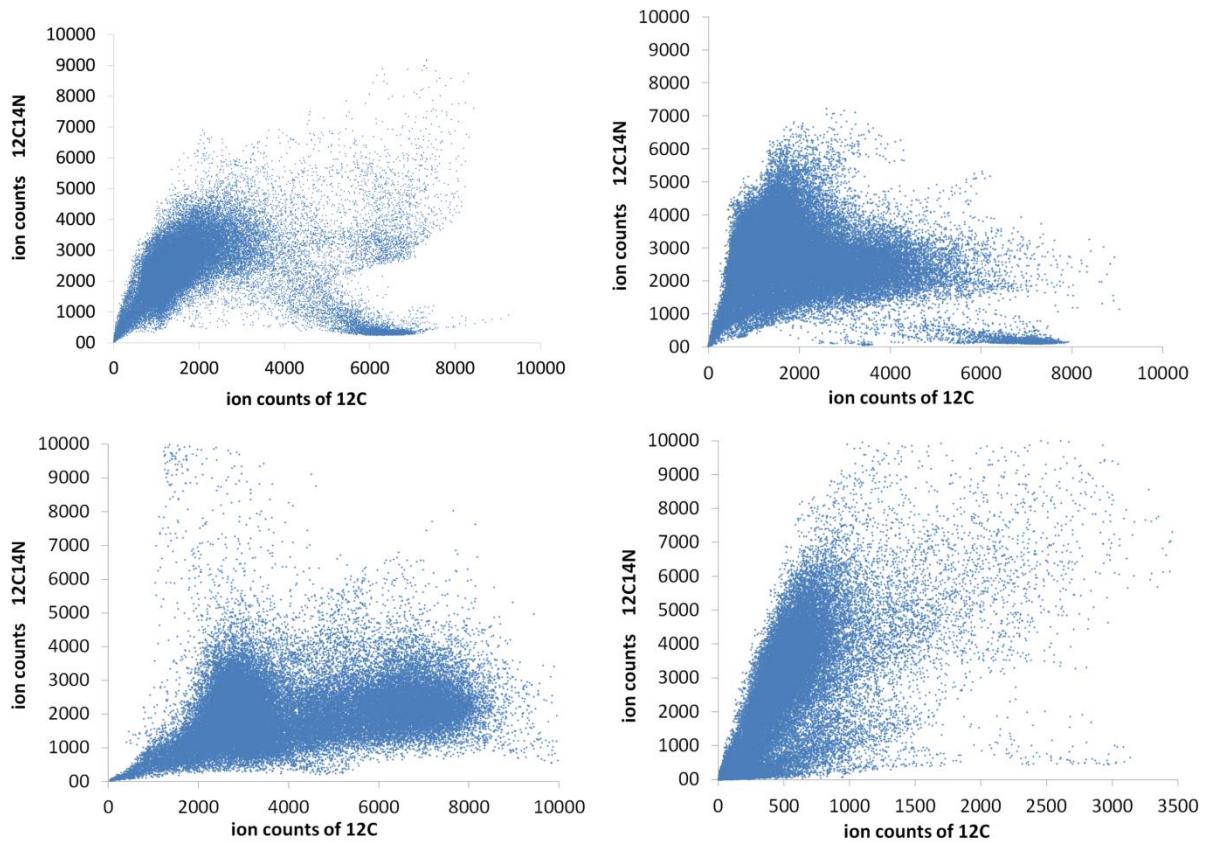
**Figure S3-1. Comparison of SEM-EDX and NanoSIMS elemental distribution data in composite images (biofilms interlayered with biotite flakes).**  
**RGB sequence of colors: red matches the first element in a row, green – second, blue - third.**



**Figure S4.** Visualization of organic matter attributed to the etching pit, Fe-coated hyphae crosses the pit (NanoSIMS data)



**Figure S5.** Visualization of organic matter attributed to the etching pits. Composite image, the first element in pair is imaged in red, the second – in green (NanoSIMS data).



**Figure S6.** Scatter plots of the secondary ions counts ( $^{12}\text{C}^-$  and  $^{12}\text{C}^{14}\text{N}^-$ ) reveal several different organic matter generations that are present in parallel in endolithic organo-mineral horizons (NanoSIMS data).

**Secondary ions colocalization in endolithic organo-mineral horizon  
from the Larsemann Hills, East Antarctica**

(NanoSIMS data, correlation matrix upon Pearson's  $r$  between ions counts)

	$^{12}\text{C}^-$	$^{16}\text{O}^-$	$^{12}\text{C}^{14}\text{N}^-$	$^{28}\text{Si}^-$	$^{32}\text{S}^-$	$^{27}\text{Al}^{16}\text{O}^-$	$^{56}\text{Fe}^{16}\text{O}^-$
$^{12}\text{C}^-$	1,00	0,01	0,85	0,33	0,62	0,16	-0,12
$^{16}\text{O}^-$	0,01	1,00	0,31	0,47	0,52	0,90	0,66
$^{12}\text{C}^{14}\text{N}^-$	0,85	0,31	1,00	0,46	0,86	0,52	0,10
$^{28}\text{Si}^-$	0,33	0,47	0,46	1,00	0,30	0,61	-0,11
$^{32}\text{S}^-$	0,62	0,52	0,86	0,30	1,00	0,65	0,49
$^{27}\text{Al}^{16}\text{O}^-$	0,16	0,90	0,52	0,61	0,65	1,00	0,54
$^{56}\text{Fe}^{16}\text{O}^-$	-0,12	0,66	0,10	-0,11	0,49	0,54	1,00

**Chemical composition of organic matter in endolithic system from the Larsemann Hills,  
East Antarctica according to the  $^{13}\text{C}$ -CPMAS NMR**

Organic matter generations	Chemical shift regions under consideration of spinning side bands, proportion [%]				
	Alkyl	O/N-Alkyl	Aryl	Carboxyl	Alkyl / O/N-Alkyl
Brown varieties	8,69	80,66	2,66	7,92	0,11
Green varieties	18,30	56,48	11,69	12,41	0,32